

Fingerprint Image Segmentation using Global Thresholding

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Abstract

In fingerprints minutiae can be used as identification marks for fingerprint verification. For minutiae extraction in fingerprints with varying quality this paper uses preprocessing in form of image enhancement and binarization is first applied on fingerprints before they are evaluated. Then Image segmentation is used for the finger print image processing in that case the block direction estimation and ROI is used . Many methods have been combined to build a minutia extractor and a minutia matcher. It is necessary to segment the image before recognizing the finger print images. For this several image segmentation approaches are available to segment the image, to change the representation of the image or to simplify the image to make it more meaningful and easy to analyse. Image segmentation is the process of partitioning an image into multiple segments. This paper is describing the approach to image segmentation by performing direction flow and the ROI. Also this approach will be very helpful in digital image watermarking application for more efficient embedding of watermark.

Keywords: component: Minutia , Region of Interest(ROI),Finger print

1. Introduction

In the computer vision , image plays a very vital role for conveying information. By understanding images the information extracted from them can be used for various tasks like: authentication and identification of the owner in Biometric System, navigation of robots, extracting malign tissues from body scans, detection of cancerous cells, and identification of an airport from remote sensing data. Now there is a need of a method, with the help of which, we can understand images and extract information or objects, these objectives are fulfilled by image segmentation (Rajeshwar Dass et al ,2012). In computer vision, image segmentation is the process of partitioning a digital image into multiple segments . The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyse (Linda G. Shapiro et al ,2001). Segmentation could be used for object recognition like fingerprint recognition, occlusion boundary estimation within motion or stereo systems, image compression, image editing, or image database look-up (S.Dhanalakshmi et al,2012). Some of the major applications of segmentation are Medical Imaging like locate tumors and other pathologies, measure tissue volumes, computer-guided surgery, etc. Various other fields where image segmentation is being used: locate objects in satellite images (roads, forests, etc.), face recognition, fingerprint recognition, traffic control systems, brake light detection, machine vision, etc.

A biometric authentication is essentially a pattern-recognition that makes a personal identification by determining the authenticity of a specific physiological or behavioral characteristic possessed by the user. An important issue is designing a practical approach to determine how an individual is identified. An authentication can be divided into two modules(WUZHLI):

- a.) Enrollment module
- b.) Identification or Verification module

In enrollment, a biometric system is trained to identify a specific person. In verification systems, the step after enrollment is to verify that a person is who he or she claims to be In identification systems, the step after enrollment is to identify who the person is.

2. Biometric System

The term Biometric comes from the Greek word bios which mean life and metrikos which means measure. It is well known that humans intuitively use some body characteristics such as face, gait or voice to recognize each other. Since, a wide variety of application requires reliable verification schemes to confirm the ID of an individual, recognizing human on basis of their characteristics(Dakshina Ranjan Kisku, et al 2011). The characteristics are fingerprint ,iris, face etc.

A simple biometric system consists of four basic components (S. Prabhakar et al 2003):

1. Sensor module witch acquires the biometric data.

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2. Feature extraction module where the acquire data is processed to extract feature vectors.
3. Matching module where attribute vectors are compared against those in the template.
4. Decision-making module in which the user’s identity is established or a claimed identity is accepted or rejected.

2.1 Fingerprint Biometrics

Fingerprints are unique for each finger of a person including identical twins. One of the most Instead; only a touch provides instant access. Fingerprint systems can also be used in identification mode . The biometric fingerprint sensor takes a digital picture of a fingerprint. The fingerprint scan detects the ridges and valleys of a fingerprint and converts them into ones and zeroes. Complex algorithms analyze this raw biometric scan to identify characteristics of the fingerprint, known as the “minutiae”. Minutiae are stored in a template, but only a subset of these has to match for identification or verification. The images acquired by these sensors are used by the feature extraction module to compute the feature values S. (Prabhakar et al 2003) . The feature values typically correspond to the position and orientation of certain critical points known as minutiae points (ridge endings and ridge bifurcations) that are present in every fingerprint .



Figure 1: A Fingerprint Image

3. Proposed System

We propose an enhancement process and image segmentation. We use histogram equalization for contrast expansion and DFT for linear filtering which found in many applications such as quantum mechanics, noise reduction and image reconstruction. This is followed by the image binarization process. Then the image segmentation is used .Then the next step is minutiae Extraction, Minutiae post-processing, and then minutiae based matching is used.

The steps for proposed system is as follows.

- 1) Image preprocessing
- 2) Converting the image in to gray
- 3) Image Enhancement by using histogramequalization
- 4) Image Binarisation.
- 5) Image Segmentation by using basic global Thresholding.

4. Image Segmentation Techniques

A variety of image segmentation methods has been proposed in the past decades. Different segmentation

techniques are present in the literature, all methods are not equally good for a particular type of image. Thus, in spite of several decades of research, there is no universally accepted method for image segmentation and therefore it remains a challenging problem in image processing and computer vision. Based on different technologies, image segmentation approaches are currently divided into following categories (Rajeshwar Dass et al, 2012)

A. *Threshold based segmentation:* Input image $f(i, j)$, output image $g(i, j)$.

$$g(i, j) = \begin{cases} 1 & \text{for } f(i, j) \geq \text{Threshold,} \\ 0 & \text{for } f(i, j) < \text{Threshold.} \end{cases}$$

Histogram thresholding and slicing techniques are used to segment the image. They may be applied directly to an image, but can also be combined with pre- and post-processing techniques.

Advantages

- Simple technique, long time and more often used.
- Easy in hardware, intrinsically parallel.

Disadvantages

- The threshold is a parameter which is difficult to adjust automatically in general.
- Works only for subclass of images in which objects are distinct from background in intensity (Prabhishek Singh 2013).

Image segmentation by thresholding is a simple but powerful approach for segmenting images having light objects on dark background (Rafael C. Gonzalez, 2007). Thresholding technique is based on image space regions i.e. on characteristics of image. Thresholding operation convert a multilevel image into a binary image i.e., it choose a proper threshold T, to divide image pixels into several regions and separate objects from background. Any pixel (x, y) is considered as a part of object if its intensity is greater than or equal to threshold value i.e., $f(x, y) \geq T$, else pixel belong to background (K. G. Gunturk, L. Aurdal, et al, 2006). As per the selection of thresholding value, two types of thresholding methods are in existence (Y. Zhang et al, 1994) global and local thresholding. The following figure shows the thresholding.

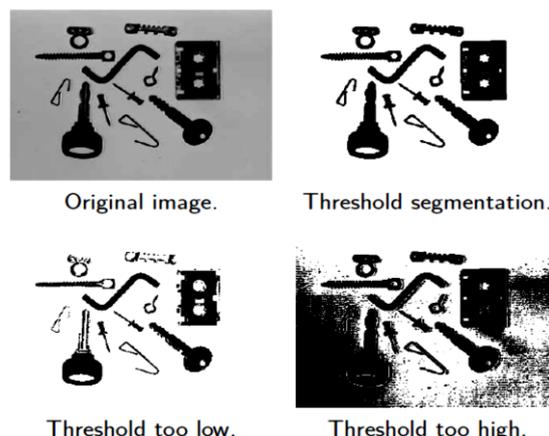


Fig 1: Thresholding

B. Edge based segmentation: With this technique, detected edges in an image are assumed to represent object boundaries, and used to identify these objects. This method attempts to resolve image segmentation by detecting the edges or pixels between different regions that have rapid transition in intensity are extracted (Rafael C et al ,2007) and linked to form closed object boundaries. The result is a binary image. Based on theory there are two main edge based segmentation methods- gray histogram and gradient based method . The following figure shows the edge based thresholding.

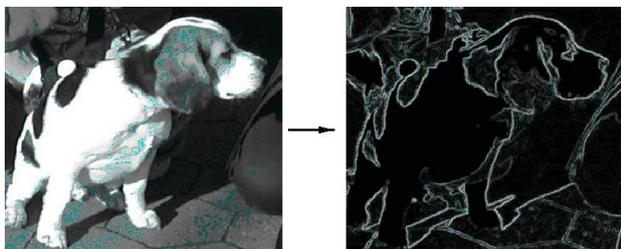


Fig 2 : Edge based segmentation.

C. Region based segmentation: Compared to edge detection method, segmentation algorithms based on region are relatively simple and more immune to noise . Edge based methods partition an image based on rapid changes in intensity near edges whereas region based methods, partition an image into regions that are similar according to a set of predefined criteria (C. Gonzalez el at, 2007). Where an edge based technique may attempt to find the object boundaries and then locate the object itself by filling them in, a region based technique takes the opposite approach, by (e.g.) starting in the middle of an object and then “growing” outward until it meets the object boundaries. The following figure shows the Region based segmentation.

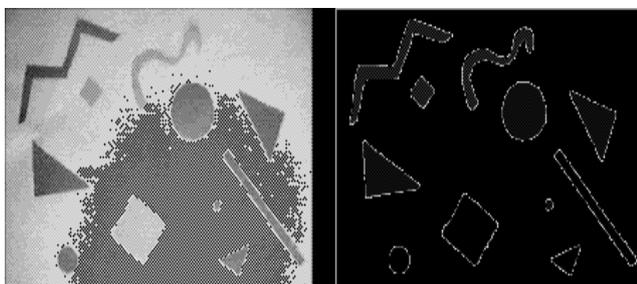


Fig 3 : Region based segmentation.

D. Clustering Techniques: Although clustering is sometimes used as a synonym for segmentation techniques, we use it here to denote techniques that are primarily used in exploratory data analysis of high-dimensional measurement patterns. In this context, clustering methods attempt to group together patterns that are similar in some sense. This goal is very similar to what we are attempting to do when we segment an image, and indeed some clustering techniques can readily be applied for image segmentation Rafael (C. Gonzalez el at, 2007).

5 Basic Global Thresholding algorithm

The image processing preferred approach is to use an algorithm capable of choosing a threshold is based on image data.

The following iterative procedure is as follows(Rafael C. Gonzalez,2010).

1. Select an inietial estimate for global threshol, T.
2. Segment the image using T. This produce two groups of pixels.G1consisting of all pixels with intensity values greater than T and G2 ,consisting of all pixels with intensity values less than or equal to T.
3. The average intensity values m1 and m2 is calculated for the pixel in region G1 and G2.
4. Threshold value is computed T.
5. Repeat step 2 through 4 until the difference in T in successive iteration is smaller than a predefined value.
6. The image is segmented bt using im2bw function.

In terms of segmentation , the algorithme works well in situations where there is reasonably clear vally between the modes of histogram is related to object and background. The practical implementation is as follows.

6 Practical Implementation

The above approach is implemented on matlab programming language. Some matlab functions are used to perform some operations like dilation. Basic Global Thresholding method of thresholding applied on the image to remove the noise. The original image is shown as follows.



Fig. 4 : Original Image

The following figure shows the histogram of the image.

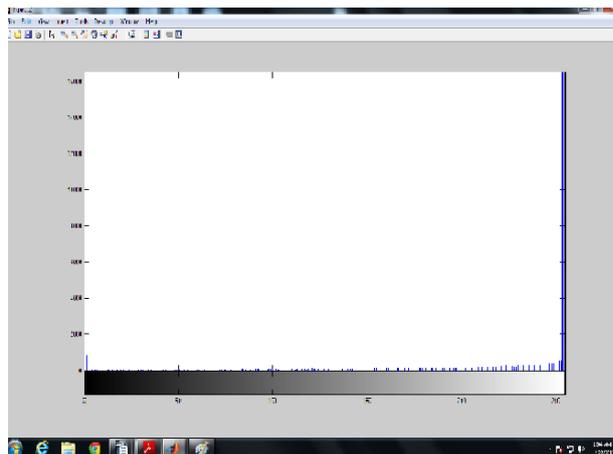


Fig 5: Histogram of the image

The following figure shows the image after basic global thresholding segmentation.



Fig 6: Image after basic global thresholding.

The algorithm converged in only two iterations, and resulted in a threshold value near a mid point of the gray scale,

Conclusion

In this paper the image segmentation is presented based on threshold. Apart from it a brief overview is given to the various types of the segmentation. Image segmentation has a promising future as the universal segmentation algorithm and has become the focus of contemporary research. Homogeneity of images, spatial characteristics of the image continuity, texture, and image content is some of the factors that affect the image segmentation.

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